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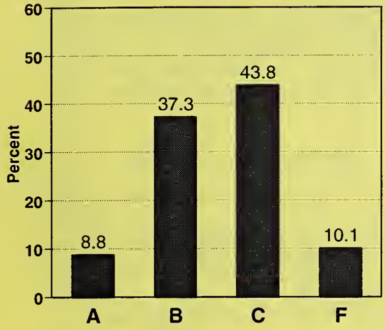
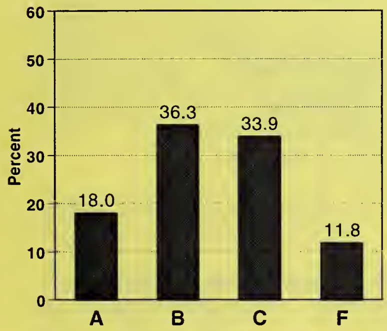
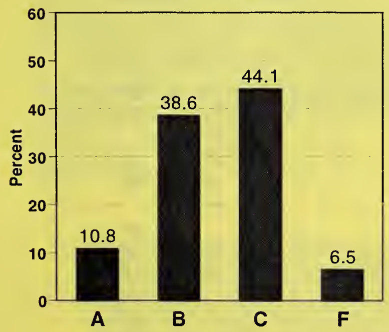
Science 30

Diploma Examination Results
Examiners' Report for January 1999


School-Awarded Mark


Diploma Examination Mark


Final Course Mark

The summary information in this report provides teachers, school administrators, and students with an overview of results from the January 1999 administration of the Science 30 Diploma Examination. This information is most helpful when used in conjunction with the detailed school and jurisdiction reports that are provided electronically to schools and school jurisdiction offices. A provincial report containing a detailed analysis of the combined January, June, and August results is made available annually.

Description of the Examination

The Science 30 Diploma Examination consists of 40 multiple-choice questions worth 50%, 12 numerical-response questions worth 15%, one short answer question worth 5%, and two long answer questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 601 students in Alberta who wrote the January 1999 examination and received a school-awarded mark.

- 93.5% of the 601 students achieved the *acceptable standard* (a final course mark of 50% or higher).
- 10.8% of students achieved the *standard of excellence* (a final course mark of 80% or higher).

Students demonstrated a good understanding of the sources of pollution and their effects. Many students demonstrated a poor understanding of field theory, including the principle of induction and how the force of a field varies with distance. While simple calculations involving electrical circuits were well done, students continue to struggle with the practical applications of electricity. Science 30 students continued to improve their communication skills. Their answers were generally well organized, and all parts of the written-response questions were addressed. Responses could have been improved by greater use of specific examples to support ideas.

Approximately 50.6% of students who wrote the January 1999 examination were female. Of these, about 88.8% achieved the *acceptable standard* on the examination, compared with 87.5% of the male students. Approximately 18.1% of the female students achieved the *standard of excellence*, compared with 17.8% of the male students. The average examination mark achieved by the female students was 66.2%, and the male students achieved an average mark of 65.7%.

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Provincial Averages

- The average school-awarded mark was 63.3%.
- The average diploma examination mark was 65.9%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 65.0%.

Results and Examiners' Comments

This examination has a balance of question types and difficulties. It is designed so that students achieving the *acceptable standard* will obtain a mark of 50% or higher, and students achieving the *standard of excellence* will obtain a mark of 80% or higher.

In the following blueprint, diploma examination questions are classified by question type: multiple choice (MC), numerical response (NR), short answer (SA), and long answer (LA). The column labelled "Key" indicates the correct response for multiple-choice and numerical-response questions. For numerical-response questions, a limited range of answers was accepted as being equivalent to the correct response. For multiple-choice and numerical-response questions, the "Difficulty" indicates the proportion (out of 1) of students answering the question correctly. For written-response questions, the "Difficulty" is the mean score (out of 1) achieved by students who wrote the examination.

Questions are also classified by general learner expectations (GLE). Even though some questions address more than one GLE, only one GLE was selected for the purpose of this report.

Knowledge:

GLE 1	Nervous, Circulatory, & Immune Systems
GLE 2	Genetics
GLE 3	Chemistry & the Environment
GLE 4	Gravitational, Electrical, & Magnetic Fields
GLE 5	Astronomy & the Electromagnetic Spectrum
GLE 6	The Production & Use of Energy

Skills:

SPC	Scientific Process Skills & Communication Skills

Science, Technology, Society:

STS	Connections Among Science, Technology, & Society

Blueprint

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPC	STS
MC1	D	0.784			✓				✓	✓
MC2	A	0.789				✓			✓	✓
MC3	D	0.840	✓							
MC4	B	0.561						✓	✓	✓
MC5	A	0.669	✓							✓
MC6	A	0.895	✓							
MC7	B	0.594	✓							
MC8	A	0.596	✓							✓
MC9	C	0.401		✓						✓
MC10	B	0.606	✓							✓
NR1	2431	0.928		✓					✓	
MC11	D	0.559		✓					✓	✓
MC12	A	0.443		✓					✓	✓
NR2	1234	0.795		✓					✓	
MC13	D	0.865				✓				✓
MC14	A	0.875						✓	✓	✓
MC15	A	0.291				✓			✓	✓
MC16	D	0.629				✓				
MC17	A	0.448				✓				✓
MC18	C	0.757				✓				✓
MC19	B	0.537				✓			✓	✓
NR3	4231	0.810			✓				✓	✓
NR4	3124	0.692					✓		✓	✓
MC20	B	0.686			✓					✓

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPC	STS
MC21	A	0.606						✓		✓
MC22	C	0.805				✓				✓
MC23	B	0.529			✓				✓	✓
MC24	A	0.651			✓					✓
MC25	B	0.769			✓					
NR5	3.8	0.629			✓				✓	
MC26	D	0.797			✓				✓	
MC27	D	0.436			✓					✓
NR6	3241	0.666			✓					✓
MC28	B	0.895			✓				✓	✓
MC29	C	0.905			✓				✓	✓
NR7	3241 or 1243	0.308			✓				✓	✓
MC30	D	0.802						✓		✓
NR8	5.00	0.705				✓			✓	✓
MC31	B	0.448				✓			✓	✓
NR9	4123	0.714						✓	✓	✓
MC32	C	0.631						✓	✓	✓
MC33	B	0.602			✓				✓	
NR10	2345	0.785						✓	✓	✓
MC34	D	0.626						✓	✓	✓
MC35	D	0.847						✓	✓	✓
MC36	A	0.722				✓				
MC37	B	0.755				✓			✓	
MC38	D	0.406				✓				
NR11	2134	0.589					✓			✓
MC39	D	0.441				✓			✓	
NR12	500	0.807				✓			✓	
MC40	B	0.672				✓			✓	
SA	—	0.601							✓	
LA 1	—	0.654							✓	
LA 2	—	0.605								✓

Subtests: Machine Scored and Written Response (Average by Subtest)

When analyzing detailed results, please bear in mind that subtest results **cannot** be directly compared. Results are in average raw scores.

Machine scored: 34.60 out of 52
Multiple choice: 26.17 out of 40
Numerical response: 8.43 out of 12

Written Response: 17.76 out of 28
Short Answer: 2.40 out of 4
Long Answer 1: 7.85 out of 12
Long Answer 2: 7.26 out of 12

Raw Score Averages by General Learner Expectation

GLE 1	Nervous, Circulatory, & Immune Systems	4.2	out of	6
GLE 2	Genetics	3.1	out of	5
GLE 3	Chemistry & the Environment	9.5	out of	14
GLE 4	Gravitational, Electrical & Magnetic Fields	10.1	out of	16
GLE 5	Astronomy & the Electromagnetic Spectrum	1.3	out of	2
GLE 6	The Production & Use of Energy	6.4	out of	9
SPC	Scientific Process Skills & Communication Skills	30.4	out of	46
STS	Connections Among Science, Technology, & Society	30.6	out of	48

Multiple-Choice and Numerical-Response Questions

The following table gives results for eight questions selected from the examination and shows the percentage of students in four groups that answered each question correctly. The comments following the table relate to some of the understandings and skills the students may have used to answer these questions.

Percentage of Students Correctly Answering Selected Machine-Scored Questions

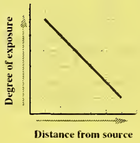
	Question Number							
Student Group	**MC15**	**MC31**	**MC16**	**MC39**	**MC2**	**NR12**	**MC19**	**MC40**
All Students	29.1	44.8	62.9	44.1	78.9	80.7	53.7	67.2
Students achieving the *standard of excellence* (80% or higher, or A) on the whole examination	52.8	57.4	80.6	60.2	91.7	95.4	74.1	74.1
Students achieving the *acceptable standard* but not the *standard of excellence* on the whole examination	25.8	44.3	60.9	41.2	80.3	82.9	53.3	67.3
Students who have not achieved the *acceptable standard* (49% or less, or F), on the whole examination	12.7	28.2	47.9	36.6	50.7	45.1	25.4	56.3

15. Sparks from static electricity pose a hazard in petroleum plants. As two charged objects separate, the field strength between them

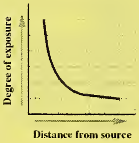
- ***A.** decreases in proportion to the square of the distance that separates them
- **B.** increases in proportion to the square of the distance that separates them
- **C.** decreases in proportion to the distance that separates them
- **D.** increases in proportion to the distance that separates them

31. Which of the following graphs represents the relationship between the distance from transmission lines and the degree of exposure to electromagnetic radiation?

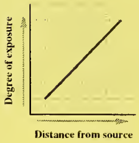
A.



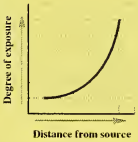
* B.



C.



D.



Multiple-choice questions 15, 16, 31, 39 provide an indication of students' knowledge and understanding of field theory.

On **question 15**, 29.1% of the students responded correctly. By choosing A or C, 79.3% of the students demonstrated that they understood that the force should decrease as the distance increased. Only the stronger students realized that the strength of the field is proportional to the square of the distance.

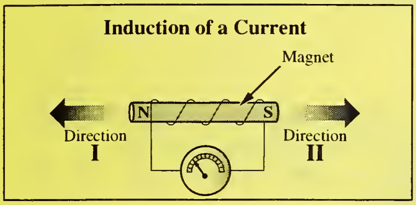
Question 31 assessed students' understanding of the same concept as question 15 with a graph rather than with text. On this question, 44.8% answered correctly. By choosing A or B, 76.9% students demonstrated that they knew that the force decreased with distance.

16. Electrical fields resemble magnetic and gravitational fields in that they all

A. have the same constant
B. cause a compass needle to swing
C. exert an attractive and repulsive force
***D.** are affected by the distance between two sources

Of the students writing, 62.9% answered **question 16** correctly, demonstrating that most students know that all fields are affected by distance. However, by choosing C, 29.6% of students indicated that they thought all three of the fields exert both attractive and repulsive forces.

Use the following information to answer the next question.



39. Which of the following statements describes induction as depicted by the apparatus shown above?

A. When the magnet is held stationary, only direct current flows in the wire.

B. When the magnet is held stationary, only alternating current flows in the wire.

C. When the magnet moves in direction I, electrons flow in the wire in the same direction as they do when the magnet moves in direction II.

***D.** When the magnet moves in direction I, electrons flow in the wire in the opposite direction as they do when the magnet moves in direction II.

Question 39 showed that many students have a limited understanding of the principle of induction, with only 44.1% of the students responding correctly. By answering C or D, 73.1% of the students demonstrated that they understood that the magnet must move in order to induce an electric current. It should be noted that Science 30 students are not required to know the "right-hand rule", but they should realize that the direction of movement or orientation of the magnetic field influences the direction of the electric current.

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2. A patient is treated for an electrical shock. When he received the shock, his skin had a resistance of 500 and he was grounded with a 115 V line. The current that flowed through his body was

***A.** 0.230 A
B. 4.35 A
C. 385 A
D. 615 A

Multiple-choice questions 2, 19, and 40, and numerical-response question 12 provide an indication of students' knowledge and understanding of electricity.

Question 2 required a calculation of current, given the voltage and resistance. Of the students writing, 78.9% responded correctly.

Numerical Response

12. To conduct an experiment aboard a space station, 24.0 V from a solar panel is transformed to 480 V. If the transformer's secondary coil has 10 000 turns of wires, the primary coil has __________ turns.

(Record your answer to three digits in the numerical-response section on the answer sheet.)

Answer: **500**

Numerical-response question 12 required a calculation using the relationship of ratios in voltage related to the ratios of turns in the primary and secondary coils of a transformer. Of the students writing, 80.7% responded correctly. As with question 2, students had little problem with this type of question. Most Science 30 students have little difficulty performing single-step calculation problems.

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19. An electric pump is used to transfer crude oil into a storage tank. To operate an electric pump from the same source as the electric motor on a pumpjack, the two should be connected in

A. parallel so the resistance is maximized and variable

***B.** parallel so the voltage can be the same for both motors

C. series so the two motors have the least effect on each other

D. series so both motors can draw the full amperage they need

Question 19 required an understanding of the use of parallel and series circuits in a real-life situation. Of the students writing, only 53.7% responded correctly.

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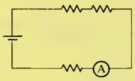
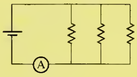
40. A technician on a space station wished to build a circuit using three identical resistors such that the circuit would have the least total resistance. Which of the following circuits would have the **ammeter** with the **highest** reading?

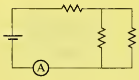
A.



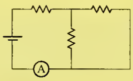
***B.**



C.



D.

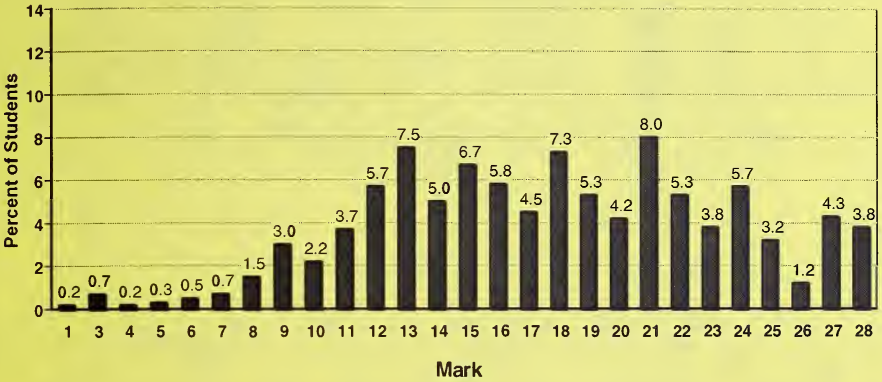


On **question 40**, 67.2% of the students responded correctly. For most students, it is counterintuitive that adding resistances in parallel decreases the total resistance of the circuit. They must know this concept to understand why the amperage in a household circuit increases as more appliances are plugged into the same circuit.

Written-Response Questions

Performance on written-response questions continues to improve. Many students are now using specific examples from science and technology in their responses. Of the students who wrote this examination, all students answered at least one of the three written-response questions, 74.0% received 14 marks or more, and 22.0% received 23 marks or more out of 28. The average mark on the written-response questions was 63.4%.

Distribution of Marks for Written Response

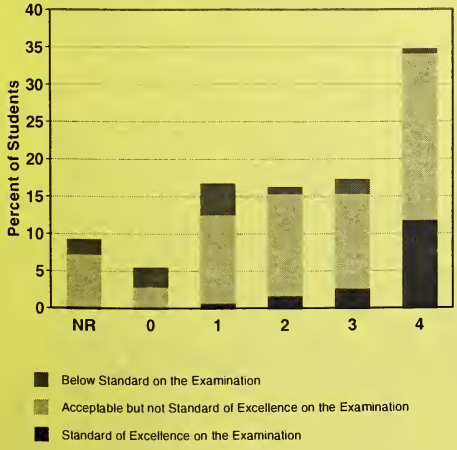


In a lab, you are asked to determine the concentration of a strong acid by titrating it with a strong base. Outline the steps you would take to carry out the titration using the following equipment and supplies. Include set-up and clean-up procedures.

buret
pipette and bulb (or pump)
Erlenmeyer flasks
graduated cylinder
indicator (bromothymol blue)
strong acid ($HCl_{(aq)}$)
funnel
distilled water
micropipette
drop plate
strong base ($NaOH_{(aq)}$)

Note: You may choose to not use all of the equipment to carry out the procedure.

Distribution of Marks for Short Answer Question 1



This **Short Answer** question required students to outline the steps in a simple titration. Most students had a general idea of the principles involved in titrations, including the proper use of indicators to signal the endpoint. The students that achieved the *acceptable standard* usually indicated a reasonable method for obtaining the volumes of the acid or base. On this question, 68.4% of the student population achieved the *acceptable standard* and 34.8% achieved the *standard of excellence*. The average mark for this question was 60.1%.

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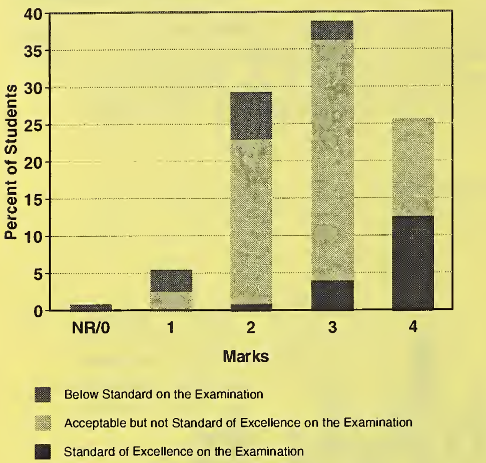
Distribution of Marks for Long Answer Question 1

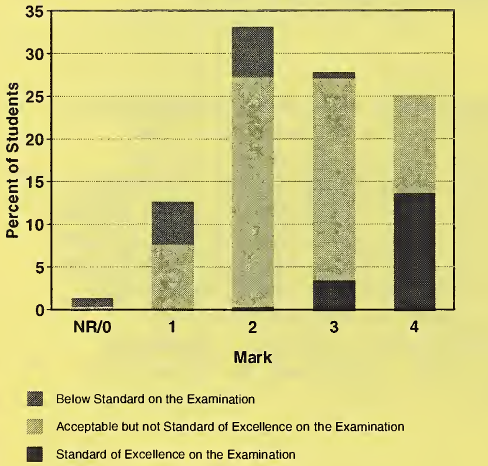


Long answer question 1 required the students to describe the mechanisms for the control of blood pressure, to identify the variables in a study, to interpret data, and to evaluate the design of a study.

Most students demonstrated a general understanding of blood pressure control. Some students identified the exercise done during the study, rather than the level of fitness, as the manipulated variable. Students who attained the *standard of excellence* were able to identify sample size and the make-up of the two groups as weaknesses in the design of the study.

On this question, the average was 65.4%, 86.2% of the student population achieved the *acceptable standard*, and 25.6% achieved the *standard of excellence*.

Distribution of Marks for Long Answer Question 2



Most of the students who attempted **long answer question 2** were able to outline some of the environmental problems that accompany electricity production and to provide some steps that could be taken to deal with the problems.

Students who achieved the *standard of excellence* provided a comprehensive list of environmental problems. The steps they described to address the problem were realistic and from a global perspective.

On this question, the average was 60.5%, 72.0% of the student population achieved the *acceptable standard*, and 25.1% achieved the *standard of excellence*.

For further information, contact John Drader (jdrader@edc.gov.ab.ca) or Corinne McCabe (cmccabe@edc.gov.ab.ca) at the Student Evaluation Branch at (780) 427-0010. To call toll-free from outside of Edmonton, dial 310-0000.

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